

## ABSTRACT

1           Methods and computer readable media are disclosed for ultimately developing a  
2 dosimetry plan for a treatment volume irradiated during radiation therapy with a radiation  
3 source concentrated internally within a patient or incident from an external beam. The  
4 dosimetry plan is available in near "real-time" because of the novel geometric model  
5 construction of the treatment volume which in turn allows for rapid calculations to be  
6 performed for simulated movements of particles along particle tracks there through. The  
7 particles are exemplary representations of alpha, beta or gamma emissions emanating  
8 from an internal radiation source during various radiotherapies, such as brachytherapy or  
9 targeted radionuclide therapy, or they are exemplary representations of high-energy  
10 photons, electrons, protons or other ionizing particles incident on the treatment volume  
11 from an external source. In a preferred embodiment, a medical image of a treatment  
12 volume irradiated during radiotherapy having a plurality of pixels of information is  
13 obtained. The pixels are: (i) converted into a plurality of substantially uniform volume  
14 elements having substantially the same shape and volume of the extended pixels; and (ii)  
15 arranged into a geometric model of the treatment volume. An anatomical material  
16 associated with each uniform volume element is defined and stored. Thereafter, a  
17 movement of a particle along a particle track is defined through the geometric model  
18 along a primary direction of movement that begins from the radiation source in a starting  
19 element of the uniform volume elements and traverses to a next element of the uniform  
20 volume elements. The particle movement along the particle track is effectuated in integer  
21 based increments until a position of intersection occurs that represents a condition where

22 the anatomical material of the next element is substantially different from the anatomical  
23 material of the starting element. This position of intersection is then useful for indicating  
24 whether a the particle has been captured, scattered or exited from the geometric model.  
25 From this intersection, a distribution of radiation doses can be enlarged from the actual  
26 radiation distributions represented by the medical image for use in various radiotherapies.  
27 The foregoing represents an advance in computational times by multiple factors of time  
28 magnitudes.